CABINET GORGE FISH HATCHERY

ANNUAL REPORT

January 1, 1991 - December 31, 1991

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INTRODUCTION

Cabinet Gorge Hatchery is located in Bonner County, Idaho approximately eight miles southeast of the small community of Clark Fork. Constructed in 1985, the hatchery produces advanced-stage late-spawning kokanee salmon fry for Lake Pend Oreille (Table 1). These fry are needed to mitigate for the loss of wild kokanee recruitment caused by hydroelectric power projects on the Pend Oreille watershed. The hatchery also controls timing of the release of these fish to coincide with the altered cycles of zooplankton blooms in the lake caused by Mysis shrimp.

Staffing at the hatchery includes 2 permanent personnel, 1 temporary year-long maintenance craftsman, 8 months of bio-aide time, and another 17 months of temporary time. Housing accommodations include two residences for the permanent staff and crew quarters for two seasonal employees.

Water Supply

Cabinet Gorge Dam is located about one mile upstream from the hatchery. After its completion in 1952 and the resultant water level rise, artesian springs began appearing along the river at the present site of the hatchery. The hatchery utilizes these springs by pumping up to 20 cfs of water to the hatchery using six pumps in two well fields. The lower spring and upper well field vary inversely with each other over a 12-month period (Figure 1). A mixture of the two water sources allowed incubation water to be kept around 50°F (10°C) to promote feed training. Production water ranged from 41.0°F (5.0°C) to 53.6°F (12.0°C) (Figure 2).

Rearing Facilities

Rearing facilities at the hatchery include 192 upwelling incubators measuring 12 inches in diameter and having a capacity of 130,000 eggs per incubator. There are 64 concrete raceways which have a rearing space of 32,000 cubic feet. Approximately one-third of the area of these is enclosed by the hatchery building. The adult holding area contains three holding ponds (10 ft x 30 ft each). A trapping area (10 ft x 20 ft) is provided at the head of the fish ladder. This past season, an extension was added to the existing ladder and joined a large holding pond where the fish were spawned. The area of this new addition is 20 ft x 30 ft. (See HATCHERY IMPROVEMENTS)

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Between January 1, 1990 and December 31, 1991, Cabinet Gorge Hatchery released or had on hand a total of 5,724,300 fish weighing 14,385 pounds (Table 2). About 6,447,000 kokanee eggs and newly hatched fry were on hand on December 31, 1991.

A total of 15,458 pounds of feed produced 13,725 pounds of gain for a conversion of 1.13 overall. Average cost per pound of feed was $0.55, resulting in a feed cost per pound of fish of $0.58. Total production cost (less capital outlay) was $182,600 (Figure 3), resulting in a cost per pound of fish of $12.42 and $31.90 per thousand.

Pend Oreille Kokanee

Rearing

Fertilized eggs are brought to the hatchery and disinfected in 100 ppm Argentyne for 15 minutes, counted using the volumetric displacement method, then placed into vertical upwelling incubators and gently rolled until eye-up. At eye-up, the flow through the incubator is increased. Fry are allowed to swim out of the incubator into the raceway at 1650 temperature units, and start on feed at about 1,650 temperature units (Figure 4).

Kokanee are feed-trained at 50°F using Rangens soft-moist starter until they are about 1.2 inches. At this time, the diet is switched to Oregon Moist Pellet (OMP) IV. Feed size starts at 1/32-inch, then to 3/64-inch, and sometimes 1/16-inch, depending on size objectives. These size objectives have changed from about 1.3 inches when the hatchery began operating to a present request of 2 inches at release (Figure 5). Consequently, the hatchery capacity number has been reduced to meet this request.

The limiting factor in fish growth here continues to be a lack of available warm water (50°F) during the production *months* (Figure 1). Although the upper well field can yield up to 20 cfs, it is too cold to be used alone and warm water from the lower springs must be added to temper it. Unfortunately, only 4.4 cfs is available from the lower springs and only 12.4 cfs can be backed up by the generator should a power failure occur.

Because egg collection lasts over two *months* and a cross- section of the run is required for each release strategy, growth rates need to be adjusted according to release timing. The growth rates of the early egg-takes are slowed by decreasing the water temperature and feeding rate. The late egg-takes are increased by raising the water temperature and feeding rate. By adjusting these parameters after the fry are feed-trained, a representative sample can be obtained from each egg-take, thus assuring optimum genetic diversity in each release (Figure 6).

A total of 5,248,572 kokanee fry were produced at an average length of 2.15 inches and an average weight of 410.3 fish per pound. These fish gained 11,836 pounds from 14,396 pounds of feed, resulting in a conversion rate of 1.22:1.0 (Table 3). Fish feed production cost was $0.628 per pound and $1.42 per thousand.

Survival of green eggs to feeding fry was estimated at 92.0% (1990, 89.5%). Survival from first feeding to release was estimated at 94.6% (1990, 90.7%), resulting in survival from green egg to release of 86.9% (1990, 81.2%) (Table 4). Survival for each egg take from collection through release is shown in Figure 7.

Fish Marking

Both of the 1991 release groups had represented sample groups fin-clipped (Table 5). A total of 60,000 Clark Fork River released fish were marked with a left ventral fin clip and 30,000 Sullivan Springs released fish were marked with an adipose fin clip. An additional 30,000 fish from the Sullivan Springs group were given a right ventral fin clip and raised on a "slow-growth" regime. The purpose of this was to determine if smaller fish return at a better rate and if larger fish at release mature earlier. These fin-clipped fish will also be used to estimate the rate of adult straying between the Clark Fork River returns and the Sullivan Spring returns.

Fish Liberations

During June 1991, 2,613,800 fish were liberated from Cabinet Gorge Hatchery into the Clark Fork River (Table 6). In July, 2,570,200 were transported from Cabinet Gorge Hatchery to Sullivan Springs. An additional 64,600 kokanee weighing 159 pounds were transferred to Sandpoint Hatchery on July 17, 1991. Because no extra kokanee were available, the south shore release at Farragut State Park boat ramp was not done this year.

Numbers at release were based upon inventory numbers made just prior to moving the fish outside, minus mortality through release. All numbers were checked with a weight/sample count number as the fish were loaded onto the trucks, except the hatchery ladder release. Our inventory numbers were below the weight/sample count numbers by about 12.9%, so we are confident that the actual number stocked is between these two numbers.

Kokanee in both releases were imprinted with morpholine at 5 x 10-5 ppm. The Clark Fork River release was imprinted for one month prior to release and two days after release, while the Sullivan Springs group was imprinted for six weeks prior to release and two days after release.

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Clark Fork River-The hatchery release group of fry were flushed at dusk, using the fish by-pass system, directly into the ladder. Only three raceways were released at any one time to prevent fry from washing against the settling pond deflector screens before entering the by-pass pipe system. The entire release took less than two hours. Tempering was unnecessary as hatchery production temperature (49°F) was close enough to the Clark Fork River water temperature of 54.5°F.

Because of the high flows in the river (63,000 cfs) during release, it was estimated that fry made it to the river in two to three hours. Quick outmigration of kokanee fry is essential for the successful rehabilitation of kokanee for Cabinet Gorge Hatchery because of the predator trap in the Clark Fork River and delta area.

Tanker Hauling-The Sullivan Springs release utilized the ten-wheel 2,100-gallon Corps of Engineers tankers. Some modifications were made to the tankers for hauling small fish. The agitators were completely closed off to prevent trapping fish inside, and the sight tubes for water displacement readings were also removed. The lids were equipped with weather stripping for a tighter seal. Level lines and flood lines were screened to prevent fry from entering.

Loading densities of small fish in the tankers ranged from 0.53 to 0.68 pounds per gallon (D.I. 1.9 - 2.5), with an average load density of 0.61 pounds per gallon.

Sullivan Springs

Tanker access into Sullivan Springs is limited. Fish were planted below the bridge on the access road to the IDFG patrol cabin. This year, a 140-foot 10-inch flexible discharge hose was placed from the release area to the trucks to eliminate driving the trucks down the hill to unload. A collapsible hose was fastened at the bottom and functioned to slow the discharge velocity during planting. Two tankers made up to two trips per day for two and one-half consecutive days to complete the plant.

It is recommended that, prior to release, a tanker load of water be used to scour out a fry release pool.

Other Fish Produced

Kokanee (1990 BY)

About 34,000 kokanee averaging 4.63 inches were on hand December 31, 1991. These kokanee were taken from spawners in the fall of 1990 and are being held as a captive broodstock to enhance declining kokanee populations in the lake.

Deadwood Kokanee

About 500,000 eyed eggs of early-running kokanee from Deadwood Reservoir in central Idaho were received from Mackay Hatchery on October 25. As of December 31, 1991, about 391,000 kokanee fry were on hand averaging 1.0 inches. These fish will be used for lowland lake stocking.

Gerrard Kamloops Rainbow

It has been reported that the Gerrard Kamloops population in Lake Pend Oreille is only about 80% pure today because of matings with domestic rainbows and westslope cutthroat trout (Leary 1986). In an attempt to strengthen the genetic base and improve the trophy fishery, plus establish a non-captive specific pathogen-free broodstock, hatchery personnel have been receiving Gerrard strain Kamloops eggs from Kootenay Trout Hatchery in Wardner, British Columbia, Canada since 1987. This has resulted in releases in 1988, 1989, and 1990.

These Gerrard strain Kamloops eggs were divided into two groups: a "coolwater" and a "warmwater" group. The coolwater group represents fish that achieve growth comparable to Gerrards in the wild. The other group is being reared on warmer water to achieve an earlier returning adult, thus providing eggs one year earlier than its wild counterpart. Until it is determined which release results in the most adults *returning* to the ladder, both groups will be used.

No Gerrard strain Kamloops eggs were received in 1990 due to a poor egg-take at Kootenay Trout Hatchery. However, on March 14, 1991, about 12,400 F2 Gerrard strain eggs were received and divided into two groups, a coolwater and warmwater group. The warmwater group remained here, while the coolwater group was transferred to Sandpoint Hatchery and will remain there until release in the spring of 1992. As of December 31, 1991, the coolwater group numbered about 5,200 and averaged 2.5 inches long, while the warmwater group numbered about 5,500 and were 4.3 inches long.

A total of 175 pounds of feed was fed to produce 153 pounds of gain for a conversion of 1.14:1. Feed production cost for these fish was $79.26, resulting in a feed cost per pound of fish of $0.52 or $0.007 per fish.

Bull trout

A bull trout program was established at Cabinet Gorge Hatchery in 1987 to advance the knowledge of bull trout culture and provide bull trout fingerlings to fisheries managers for reestablishment or enhancement of suppressed populations in Idaho. However, because of concerns about adversely affecting the genetics of the wild population in the lake with the introduction of hatchery

fish from a limited number of parents, plus the unknown predator/prey relationship, this program was discontinued in 1991. However, bull trout from the 1990 egg-take were still on hand as of December 31, 1991.

1990 Bull Trout-In October of 1990, a total of 64,090 bull trout eggs were taken. All eggs were shipped to Sandpoint Hatchery for incubation and early rearing. In October of 1991, about 13,140 fish averaging 3.27 inches in length were transferred back to Cabinet Gorge Hatchery. As of December 31, 1991, about 12,800 bull trout averaging 3.71 inches were on hand at Cabinet Gorge Hatchery.

In the 1960s, Dolly Varden Salvelinus malma were stocked into the Clark Fork River and some small tributaries on the north end of the lake. Because Dolly Varden and bull trout do not interbreed, we were curious to find out if we were collecting eggs from Dolly Varden or bull trout. Therefore, we sent samples from both the Clark Fork River and Gold Creek to Montana State University and had them examined electrophoretically.

About 25 fish from each group were sent to the genetics laboratory at Montana State University to determine possible hybridization, genetic variation within the sample, and genetic divergence between the samples.

Results-(Leary 1991) Alleles characteristic of only bull trout were detected at all diagnostic loci in both samples. Therefore, the individuals that produced these fish were undoubtedly genetically pure bull trout; however, because of the small number of parents in the sample, it can not be concluded that hybridization is not occurring.

Test results indicate that the Clark Fork River sample was comprised of mainly brothers and sisters, although the Gold Creek sample was the opposite. On the whole, when compared to 18 other populations of bull trout in the Columbia River and Klamath River drainages, these bull trout tend to have a high amount of genetic variation.

Substantial genetic differences exist between these two groups of bull trout based on research findings. These differences could indicate that the parents of the Clark Fork and Gold Creek fish came from genetically divergent populations, but based upon the available data, this can not be said with certainty. We will continue to examine these stocks in the future to determine if any differences are occurring.

Chinook Salmon

Cabinet Gorge Hatchery transferred the responsibility for the spawning of fall chinook salmon in Lake Coeur d'Alene to Sandpoint Hatchery this year because of it's proximity to the site. However, we still help with the spawntaking and provide funding for a trap tender at Wolf Lodge Creek. The eyed eggs are shipped to Mackay Hatchery where they are hatched and reared until they are stocked back

into Lake Coeur d'Alene. For information about this years spawntake, see the Sandpoint Hatchery annual report.

Westslope Cutthroat Trout

From May 31, 1991 through July 4, 1991 approximately 32,000 westslope cutthroat eyed eggs were received from Washoe Park State Hatchery in Anaconda, Montana. After disinfecting in 100 ppm Argentyne, these eggs were placed in upwelling incubators and isolated in raceways in the hatchery building until disease examination proved negative. Initial feeding began on July 2, 1991. Survival to initial feeding was estimated at 89.4%, resulting in 27,700 feeding fry. On July 17, 24,289 fry (6.66 pounds) were transferred to Sandpoint Hatchery.

In addition, 8,200 westslope cutthroat weighing 250 pounds and averaging 4.43 inches were received from Sandpoint Hatchery on October 31, 1991. Since their arrival, a total of 231 pounds of feed was fed to produce 165 pounds of gain for a conversion of 1.4:1. About 8,065 westslope cutthroat averaging about 5 inches long were present as of December 31, 1991. These fish have been graded and separated into two groups (large and small) and will be used as a potential broodstock source.

White Sturgeon

About 180 Kootenai River white sturgeon were received from Sandpoint Hatchery on November 20, 1991. About one-half of these fish were small gradeouts sent here in an attempt to increase their size on warmer water. As of December 31, 1991, 172 fish remained averaging 4.19 inches long. They will be stocked into the Kootenai River in July, 1992 to bolster declining numbers in this system.

HATCHERY IMPROVEMENTS

A self-guided tour display was completed in July. It consists of seven informational displays located around the hatchery and explains everything from the history of the area to when and where the adult kokanee return. Each location explains something about that particular area of the hatchery. Inside the hatchery building, more displays show the life history of the kokanee salmon, egg development, and fish identification charts. We have had many compliments about it and hopefully it will answer many questions people have, thus enabling us to use our time more efficiently.

Reconstruction of the hatchery ladder was completed in November (thanks to a matching fund contribution from Washington Water Power), just in time to trap returning kokanee. A ladder was extended from the lower trap to a new holding

facility (Figure 8). This will allow us to trap in periods of high flows and eliminates the need for netting the fish twice as has been done in the past. A trench was dug to the river from the new holding area, thus giving the kokanee an additional route to return to the trap.

Rain gutters and screen doors were added to the houses, and the bathroom, hallway, and break room of the hatchery building and the packed columns received a fresh coat of paint. Two raceways that were falling apart were repaired, along with the concrete foundation on pumps five and six. The tops of the raceway walls were painted with a non-skid paint to prevent accidents. Also, an emergency backup oxygen system was created in case the generator failed during a power outage. This would not save all of the fish, but would save some, depending upon the duration of the outage.

FISH HEALTH

Kokanee

Annual broodstock inspection of Sullivan Springs kokanee tested negative for all obligate pathogens (Table 7). These results are consistent with previous years' results from this egg source. Annual kokanee fry inspection also tested negative for all pathogens examined.

Hatching kokanee fry in one incubator in raceway #7 suffered **a** 4-hour disruption in flow on December 30, 1990. About 10% of the fry were lost initially, and numerous cases of spinal deformities were observed after the fish were put out to feed. Mortality continued to remain high (0.4%) throughout their early rearing. On March 16, 1991 a microscopic examination of six moribund fish (conducted by hatchery personnel) revealed a heavy infestation of motile rods in one individual and a light to moderate presence in the other five. A treatment of 8.4 ppm Diquat was administered for suspected Bacterial Gill Disease (BGD) for three consecutive days. Mortality continued to be high (0.4%-0.9%) for 30 days after treatment. By mid-April, mortality diminished to 0.2% (normal), and it was surmised the loss of 35,000 fry was probably a "drop out" of oxygen-deprived fish from the December 30 incident which simply ran its course.

Pathological investigation of 20 fish from raceway #7 by Eagle Fish Health Laboratory personnel revealed no pathogens and a corroboration of the water shut-off hypothesis (Table 7). There was no other incidence of fish health problems during the 1991 fish year.

Other Species

All eggs were certified disease-free or disinfected in Argentyne before entering the hatchery. If possible, other species were isolated from the Pend Oreille kokanee until released or until disease inspection had been completed.

All intra-state programs were certified by the IDFG Eagle Health Lab (Table 7). The Gerrard Kamloops and westslope cutthroat were examined by their respective agencies and certified "disease-free."

FISH SPAWNING

Fish Trapping

During 1991, the Cabinet Gorge fish trap was in operation from the middle of September to the last week of December. Kokanee began entering the trap at the end of October, with the last kokanee trapped and spawned on December 27. Trapping yielded **a** total of 5,713 late-•run kokanee (25% females and 75% males) (Table 8). Prespawning mortality of females was 9.9% compared to 1990 figures of 8.5%. Most of the prespawning mortality was due to a single loss of fish that swam through the grate on the inlet to the new ponds and died. The source of this problem has been corrected.

Spawntaking and Eggs Received

Kokanee spawntaking began on November 7 and continued to January 2, 1992. Spawning operations peaked in mid-December at Sullivan Springs (Figure 7) and Cabinet Gorge.

A total of 6,587,827 kokanee eggs were collected during the 1991-92 production year. Of those, 227,331 were obtained from 820 female kokanee at Cabinet Gorge Hatchery, and 6,352,976 were collected from the Sullivan Springs trap. About 10,089 kokanee were placed above the trap to spawn naturally and assure a future egg source. Spawning efficiency (the amount of eggs removed from the body) in 1991 was 92%, the same as last year. Another 7,520 eggs were collected by electrofishing the north shoreline of Lake Pend Oreille around Hope. About 5,110 eggs were shipped to Eastern Washington University for an imprinting experiment.

PUBLIC RELATIONS

Cabinet Gorge Hatchery is recognized by the surrounding communities as the major contributor of kokanee to the lake fishery. The importance of the lake fishery to the local economy is currently estimated at over 5 million dollars. Once the kokanee population rebounds, that figure should double. Many people see the hatchery as the "cure-all" to the kokanee decline in the lake, and we have been the focus of many radio, television, and newspaper stories in recent years. With the decline of kokanee numbers in recent years, even more attention is placed on the hatchery. Because of the popularity of the lake and its

attractions, tourism is a booming business, and we get people from all over the world visiting the hatchery.

About 500 people signed our guest registration book this year. It was estimated that about 1,500 visitors toured the hatchery during the 1990-91 season. In addition, ten tours were given to school groups and two tours were given to college-related groups. A federal program (JTPA) enabled us to provide a full-time tour guide for visitors.

In addition to the tours, about six slide presentations/talks were given to various groups. Also, we were on the local radio four times for the hour-long "Speak up North Idaho" show, plus numerous "live spots" during the spawning season. We were on local/regional television programs four times, in the local newspapers many times, and our regional newsletter twice. Joe Chapman gave a presentation at the Northwest Fish Culture Conference on baffles and rolling green eggs.

We participated in many regional activities. Some of these included sturgeon spawning, electrofishing the Pend Oreille River, fall trawling and zooplankton sampling with the research biologists, installation of the chinook trap on the Coeur d'Alene River and net pens in Lake Pend Oreille, renovation of Mirror Lake, and miscellaneous regional meetings.

SPECIAL STUDIES

Rolling Green Eggs

No fungicide was used on the 1990-91 year class of kokanee. This was the second year that the entire program depended on rolling the eggs to prevent fungal development. The principle behind this method is to gently roll the eggs to prevent fungus from starting. It is important to maintain a constant flow through the eggs during the tender period and also to assure that no dead areas develop in the incubators. This year the flow was increased slightly to prevent fungal clumping in the incubator.

Survival to fry-sort (92%, 1990-90%) was the best since hatchery operations began in 1985, thus proving the method works. Rolling green eggs eliminates the expense of fungicide, labor costs, and health risks and should be examined at other hatcheries on different species.

Baffles

Again, baffles were used during the 1990-91 fish year to move the settleable solids to the back of the raceway where they can be quickly swept into the discharge pipe. This method reduced the time spent cleaning raceways by 75% and improved the environment of the fish.

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ACKNOWLEDGMENTS

We would like to thank Gary Stockinger (WWP) and Larry Labolle (WWP) for their cooperation and funding of the new ladder/trap construction. We would also like to thank the Cabinet Gorge Dam personnel for their continued cooperation with hatchery operations. Thanks also to the Lake Pend Oreille Idaho Club and Regional department personnel for their cooperation during the spawning season.

LITERATURE CITED

Leary, Robb. 1986. University of Montana, Personal Communication.

Table 1. Kokanee requested and produced.

Species & size	Production coal	Actual production	Percentage of goal achieved
Kokanee fry	15,000,000	5,248,600	35.0%

[a]Egg take was 35.8% of requirement for full production.

Table 2. Production summary, all species, 1990-1991.

Species	Number	Pounds	Length	Fish/ lb	Average feed cost/ lb	Conv- ersion	Production cost	Cost/ lb of fish
PdO KL	5,248,600	12,792	2.15	421	0.52	1.25	155,210	12.42
Brood KL *	33,800	1,008	4.63	34	0.46	0.97	14,991	14.87
KE *	391,000	122	1.00	3,200	0.73	1.12	1,631	13.37
K2 *	5,500	156	4.34	35	0.45	1.15	2,084	13.36
C2 (Fing) *	8,100	415	5.28	19	0.39	1.40	5,545	13.36
C2 (Fry) *	24,300	7	0.97	3,647	0.73	1.07	145	20.71
Bull Trout*	12,800	196	3.71	66	0.42	1.91	2,619	13.36
Sturgeon *	200	4	4.19	55	0.42	2.00	375	93.75
Totals/ Average:	5,724,300	14,700	2.09	389	0.55	1.13	182,600	12.42

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Table 3. Kokanee production summary, Cabinet Gorge Hatchery, 1991.

Lot #	Number Produced	Pounds Produced	Number Per Pound	Feed Fed	Weigh t	Conversion
CF REL	2,648,398	6,549	404.4	7,196	6,068	1.19
SS REL	2,600,174	6,243	416.5	7,200	5,768	1.25
TOTAL:	5,248,572[a]	12,792	410.3	14,396	11,836	1.22

[a]This figure includes 64,500 (159.2 lbs) transferred to Sandpoint Hatchery on July 17, 1991.

Table 4. Survival summary, kokanee salmon, Cabinet Gorge Hatchery, 1990-91.

		SURVIVAL		
Lot #	Number Green Eggs	Green Egg to First Feeding	Green Egg to Release	Feeding fry
CF	3,029,514	.92	.87[a]	0.95
SS	3,008,594	.92	.86[b]	0.94
Total:	6,038,108	.92	.87	0.946

[a]34,561 transferred tp Sandpoint Hatchery.
[b]29,910 transferred to Sandpoint Hatchery.

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Table 5. Differential marks applied to different release groups of kokanee fry produced at Cabinet Gorge Hatchery, 1991.

Release Date	Release Site	# Fish Released	Percent Marked	Fin Clip		
				Ventral		
				Left	Right	Adipose
June 26	CFR-CG	2,613,800	2.3	X[a]		
July 9-10	SS	2,570,200	1.2		X[b]	
July 9-10	SS	same	1.2			X[c]
		5,184,000				

[a]60,000 marked
[b]30,000 marked (slow growth group)
[c]30,000 marked

Table 6. Kokanee liberation from Cabinet Gorge Hatchery, June-July 1991.

Date	Release site	# Fish Released	Time	Length inches	#/lb
June 26	Clark Fork River	2,613,800	dusk	2.07	405.6
July 9-10	Sullivan Springs	2,570,200	day	2.22	415.3
TOTAL:	Pend Oreille Drainage	5,184,000		2.15	410.3

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Table 7. Fish health summary, Cabinet Gorge Hatchery, 1990-91.

	Sample Dates	VH	VP	VE	BK	BR	BF	BC	PW	PC
Adults										
SS kokanee	11-28-90	-	-	-	-	x	x	x	-	-
CF kokanee	11-29-90	x	x	-	-	x	x	x	-	-
Fry										
SS kokanee	3-23-91	-	-	x	-	x	x	x	x	x
CAN-K2	5-02-91	-	-	x	x	x	x	x	x	x
SS kokanee	5-02-91	-	-	x	x	x	x	x	x	x
SS kokanee	12-30-91	-	x	x	-	x	x	x	x	x
Eyed Eggs Received										
MON-C2[a] (westslope)	5-29-91	-	-	-	-	-	-	x	-	x

[a]Inspected by Montana Department of Fish, Wildlife, and Parks prior to shipment.

\+ Positive results -
Negative results x
Not sampled

VH=IHNV, infectious hematopoitic necrosis virus
VP=IPNV, infectious pancreatic necrosis virus
VE=EIBS, erythrocytic inclusion body syndrome virus
BK=bacterial kidney disease
BR=enteric red mouth
BF=bacterial furunculosis
PW=whirling disease agent, Mvxobolus (Myxosoma) cerebralis
PC=Ceratomyxa shasta, agent of ceratomyxosis

Table 8. Late-run kokanee trapping at Cabinet Gorge Hatchery, 1991-92.

Month	Total		Males		Females		Prespawning Female Mortality	
	1991	(1990)	1991	(1990)	1991	(1990)	1991	(1990
Nov	3,159	(3,904)	2,817	(2,783)	342	(1,101)	4	(20)
Dec	2,554	(1,087)	1,461	(571)	1,093	(407)	138	(109)
Jan	0	(0)	0	(0)	0	(0)	0	(0)
Total:	5,713	(4,991)	4,27	(3,354)	1,435	(1,50	142	(129)

AVERAGED MONTHLY WATER TEMPERATURE IN UPPER WELL & LOWER SPRINGS, BY 86-91.

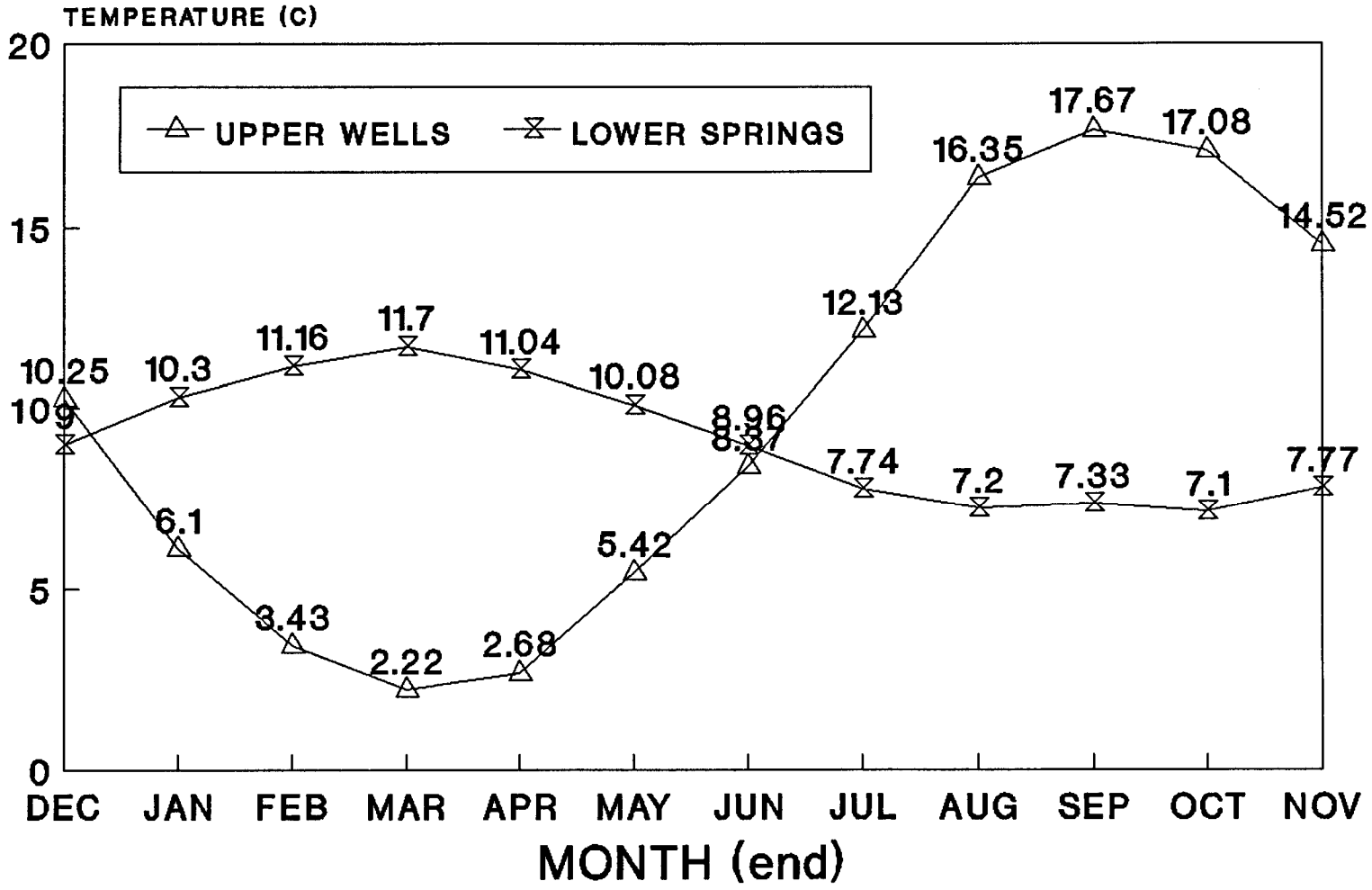

Figure 1. Temperature profile of both water sources, 1986-91

PRODUCTION AND INCUBATION TEMPERATURES 1990-91

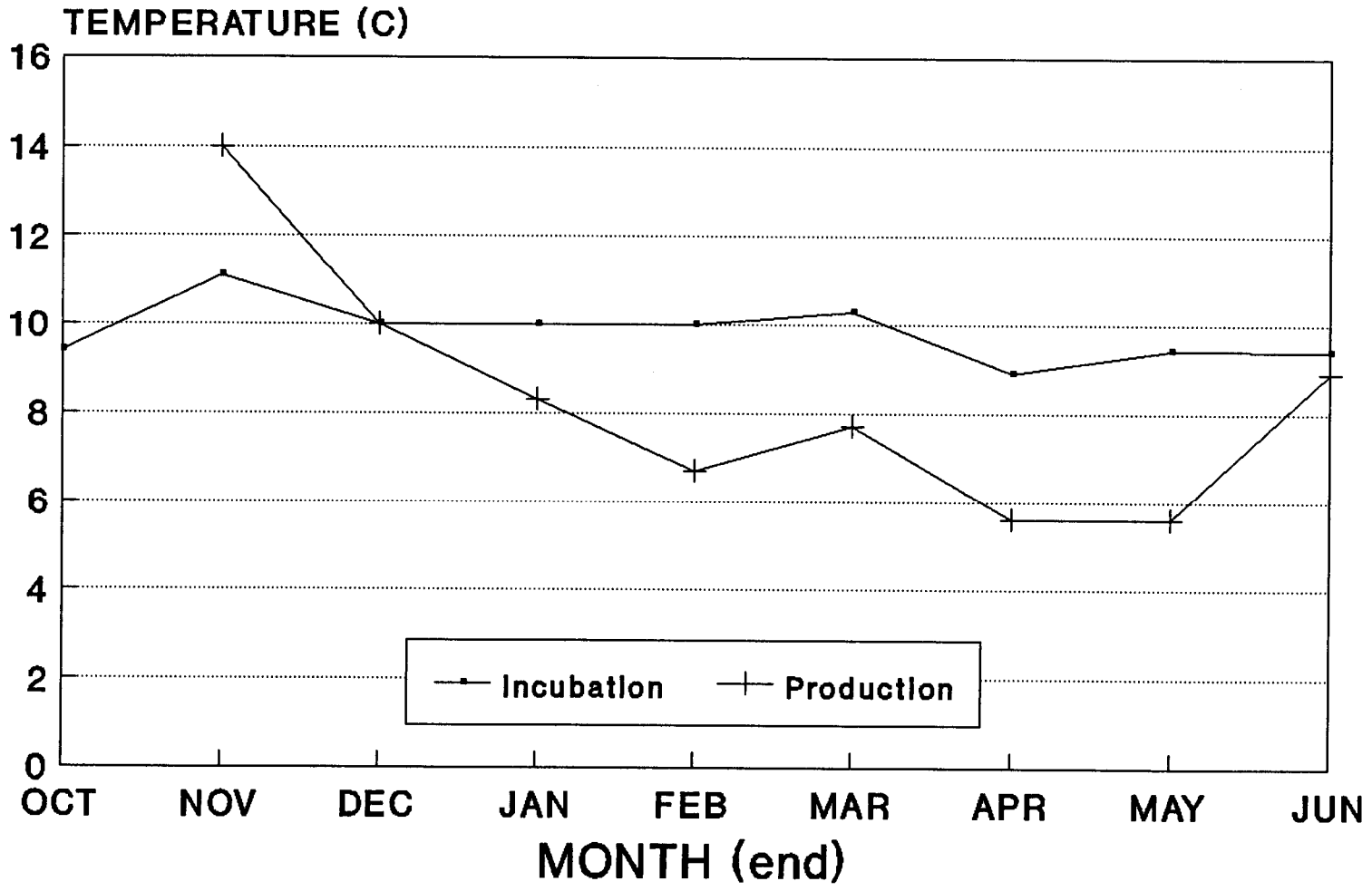

Figure 2. Temperature profile of rearing water, 1990-91.

PRODUCTION COSTS FOR 1990-91
BUDGETARY BREAKDOWN

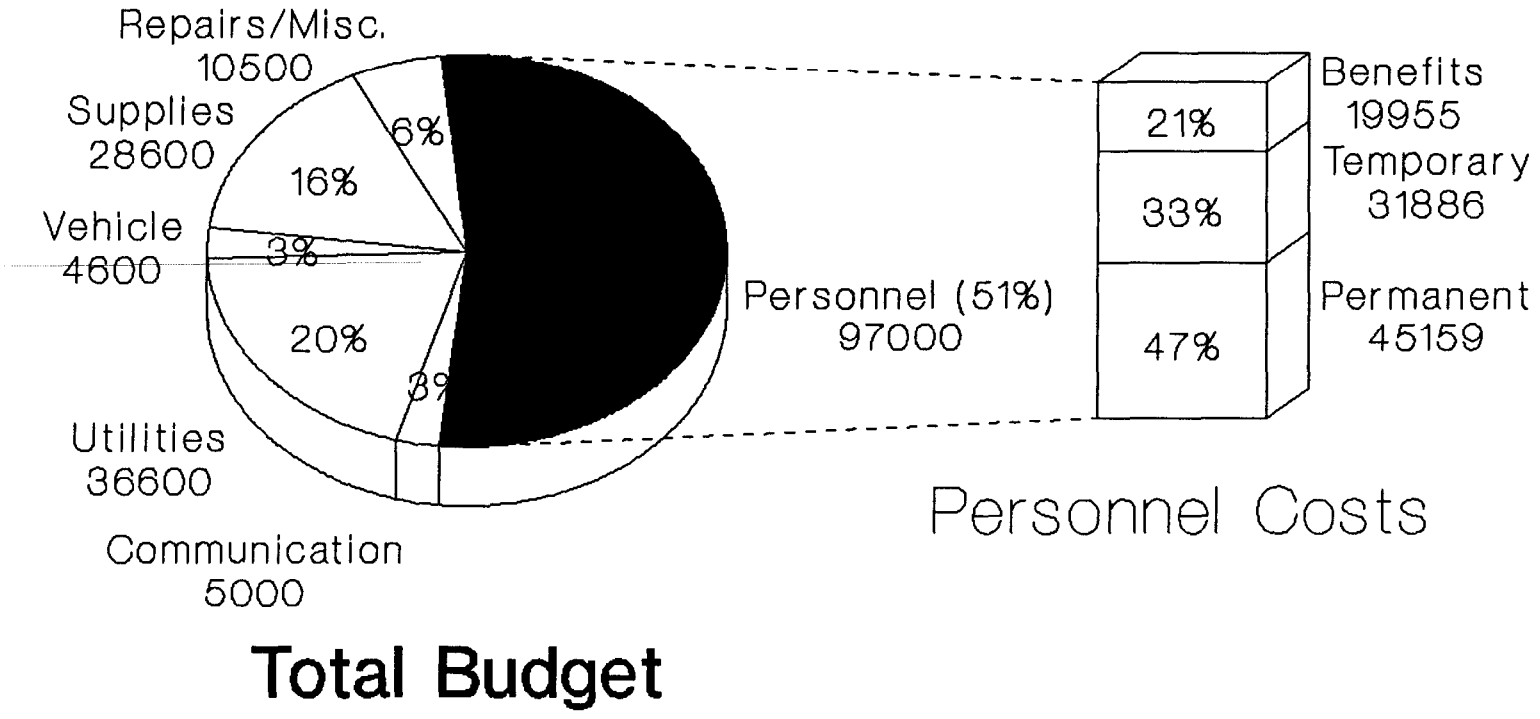

Figure 3. Production cost breakdown, 1990-91.

Kokanee Development Chart

TU's (F) needed

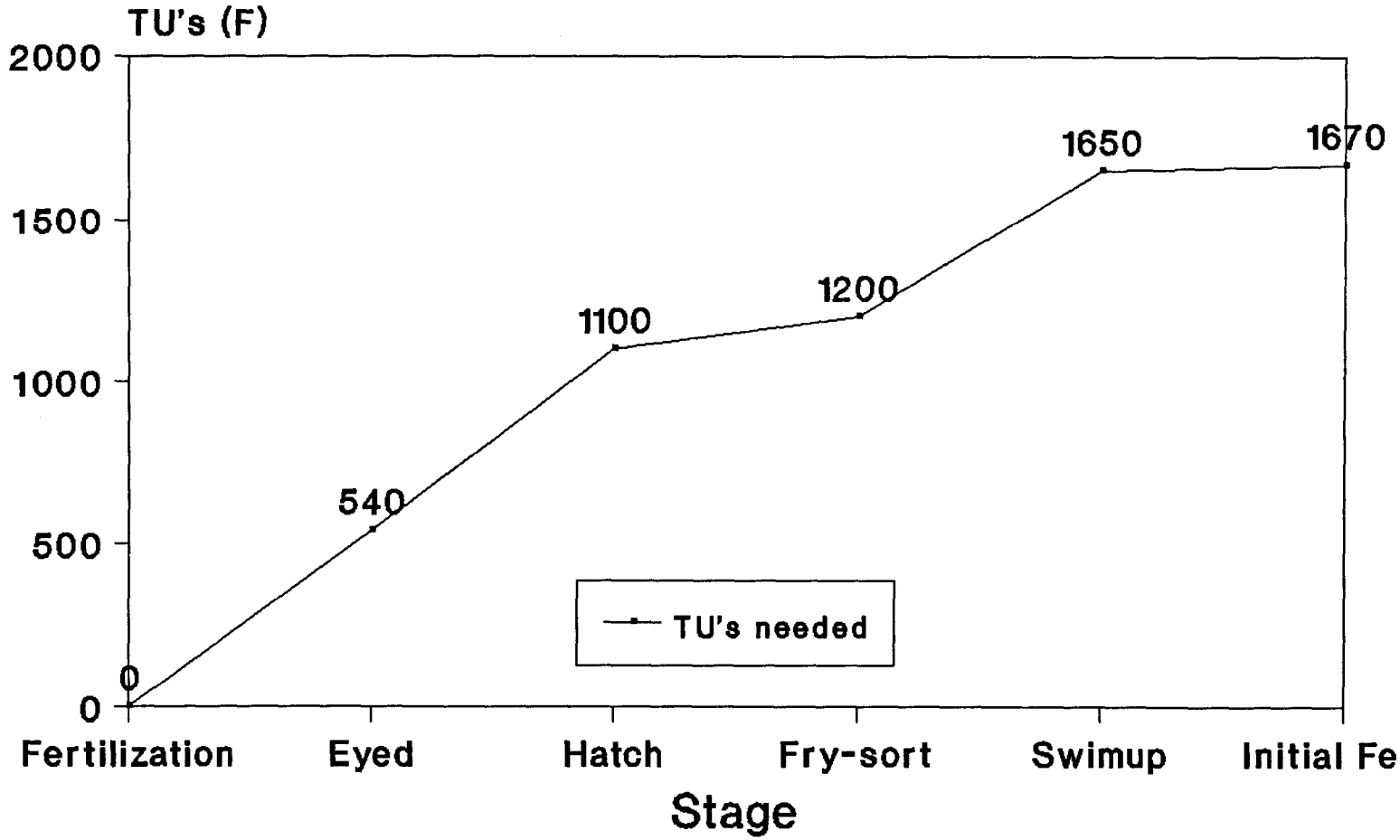

Figure 4. Kokanee development chart

Kokanee Lengths at Release
for different years and releases

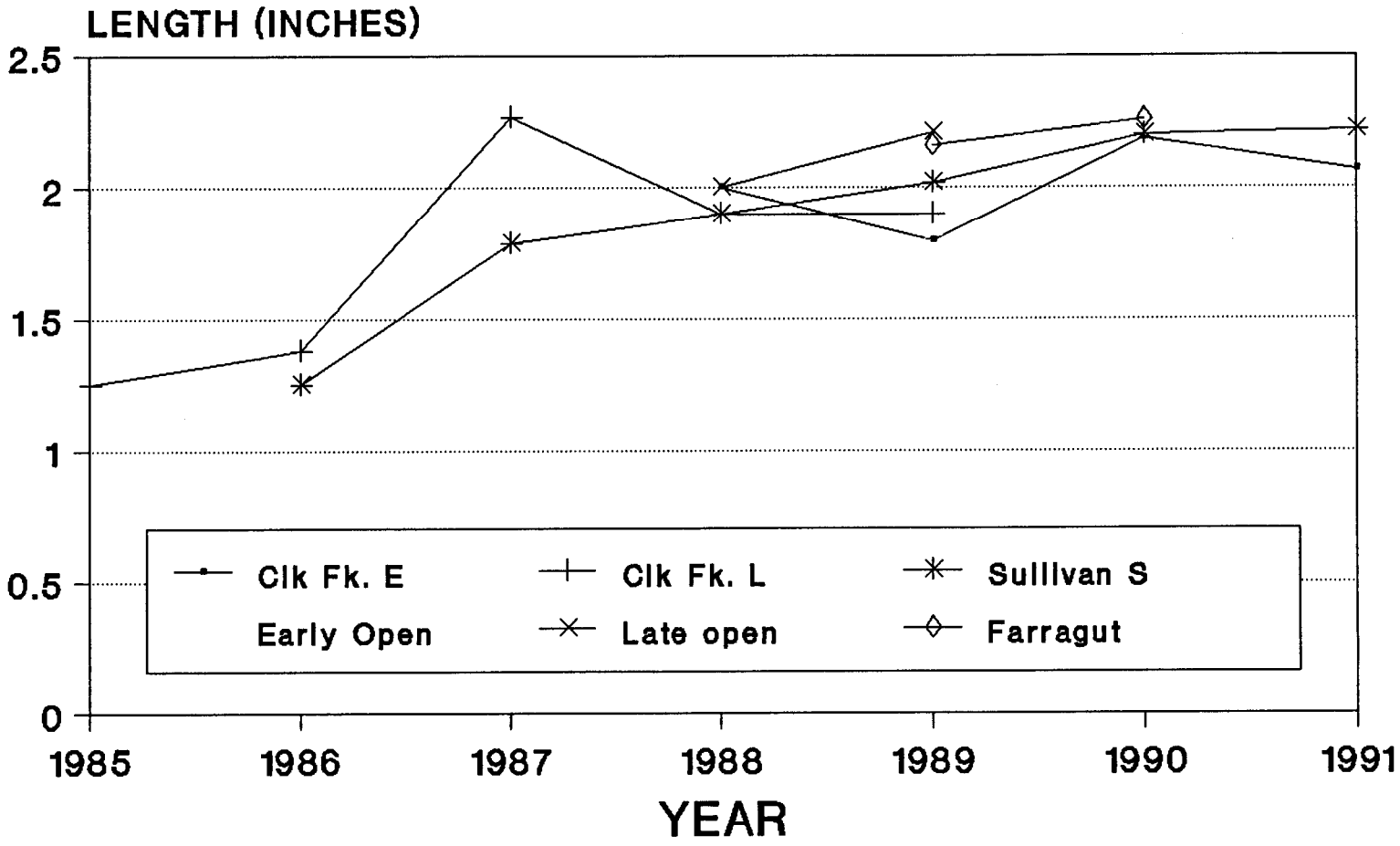

Figure 5. Kokanee length at release by location, 1985-91.

KOKANEE GROWTH RATES
FOR VARIOUS RELEASE SITES, 1991

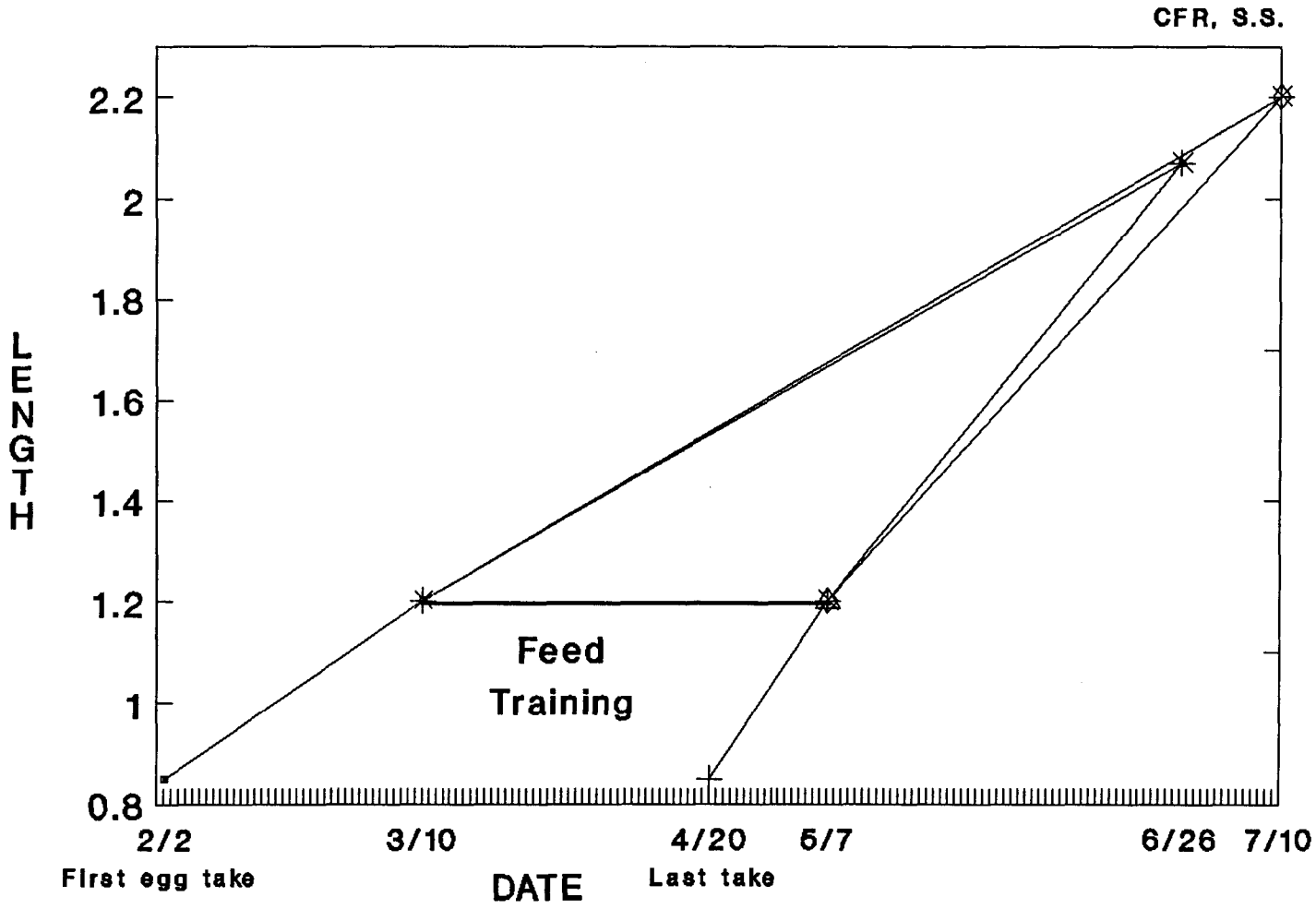

Figure 6. Kokanee growth rates for both releases, 1991.

GRANITE CREEK SPAWNTAKES
and % survival to release, 1990-91.

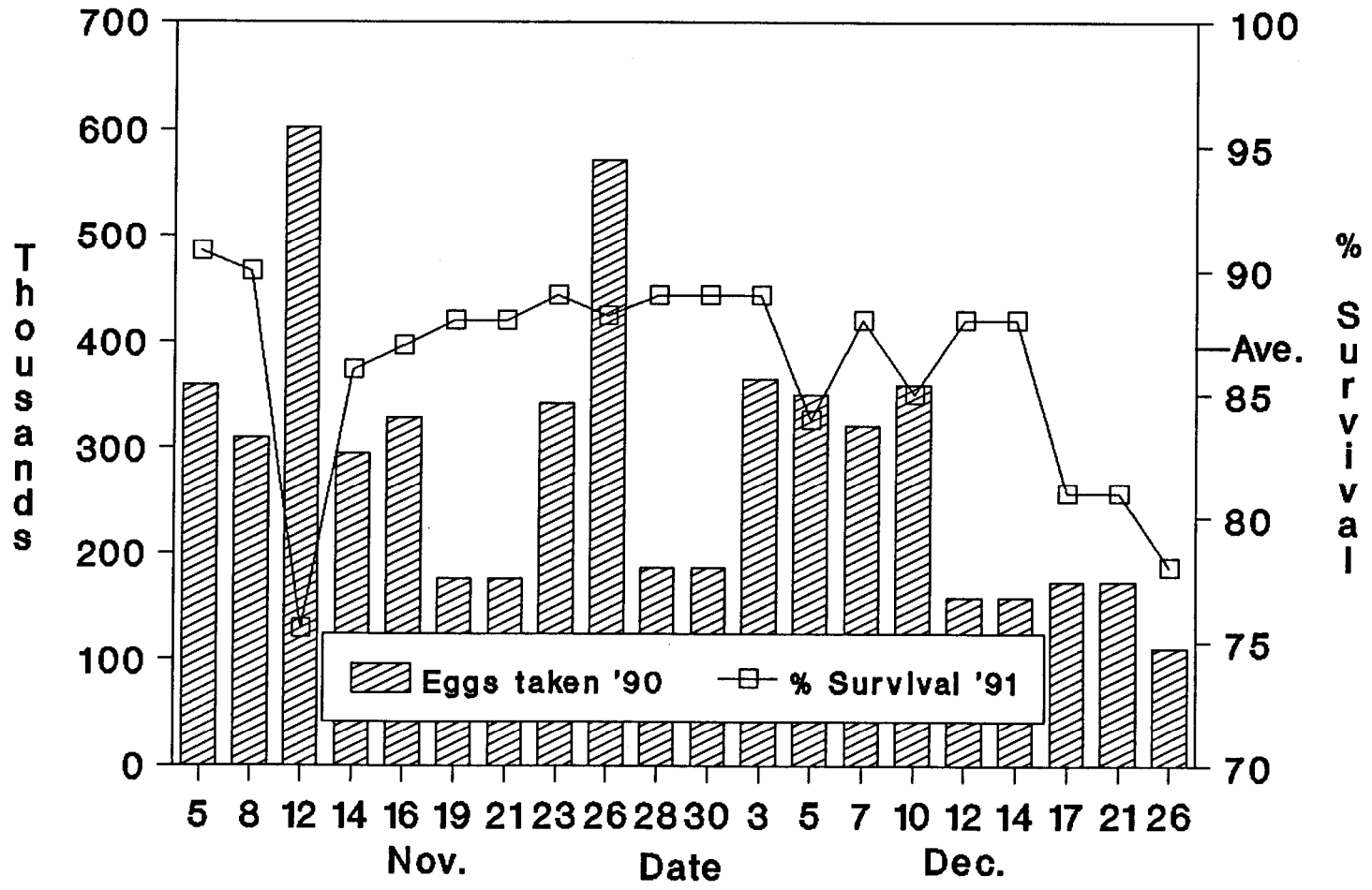

Figure 7. Granite Creek egg takes and % survival to release

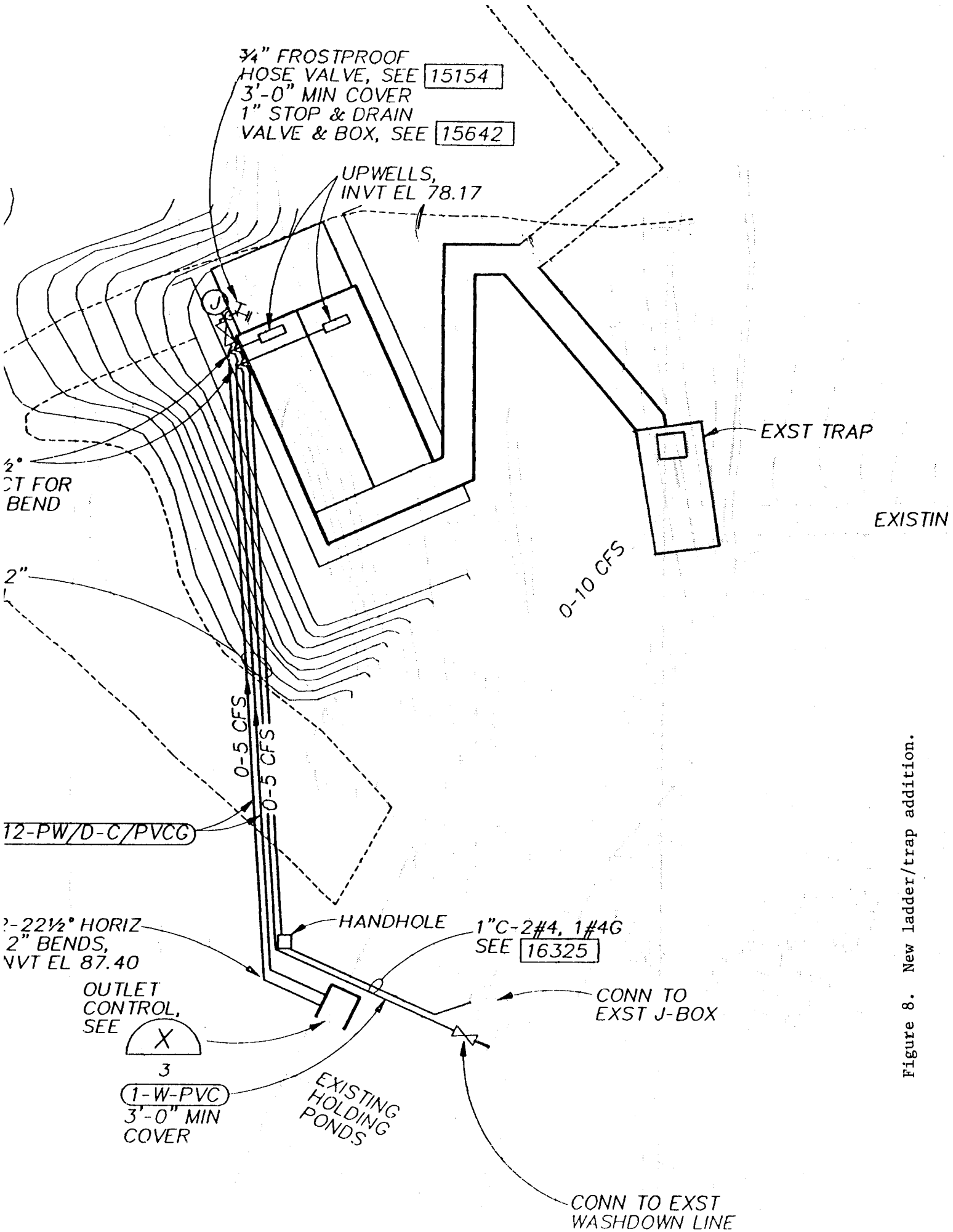

Figure 8. New ladder/trap addition.

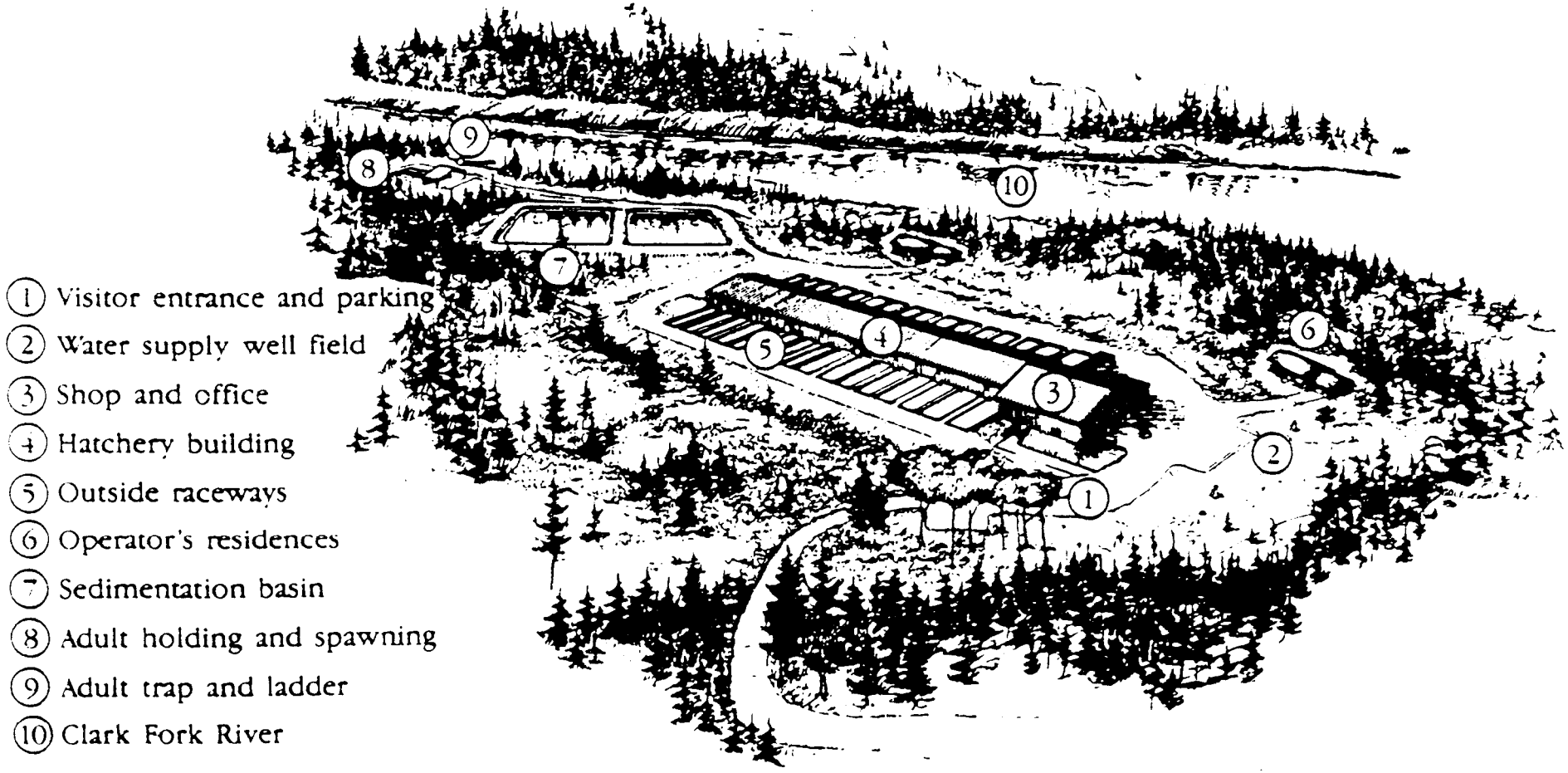

Figure 9. Hatchery layout.